ULTRAPURE MICRO 2021

# Evaluating Three Generations of UPW Filtration Technology Using SEMI C79

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# Outline

- Introduction
- Rinse Data
- Retention Data
- Conclusions

# Need for New Retention Rating Methodology

**Current Issues:**

- Historical retention rating methodology such as GNP, bubble point, and LPC measurements have reached their limits to predict the performance of the filter in the most advance tech nodes.
- The use of production tools to screen new filter technologies is time consuming and costly

**Potential Solution:**

- SEMI C79 is emerging as a useful methodology in the industry in the evaluation of retention in UPW down to 5nm.
- Recent UPM Publications:
  - 2016: Characterizing the Retention of UPW Filters Using a Polydispersed Silica Challenge by Gary van Schooneveld and Uwe Beuscher
  - 2016: How to Rate a Sub 10nm Filter by Gerd Heser and Jochen Ruth
  - 2018: Filter Media Removal Characteristics in the Low nm Range by Jochen Ruth and R. Berndt

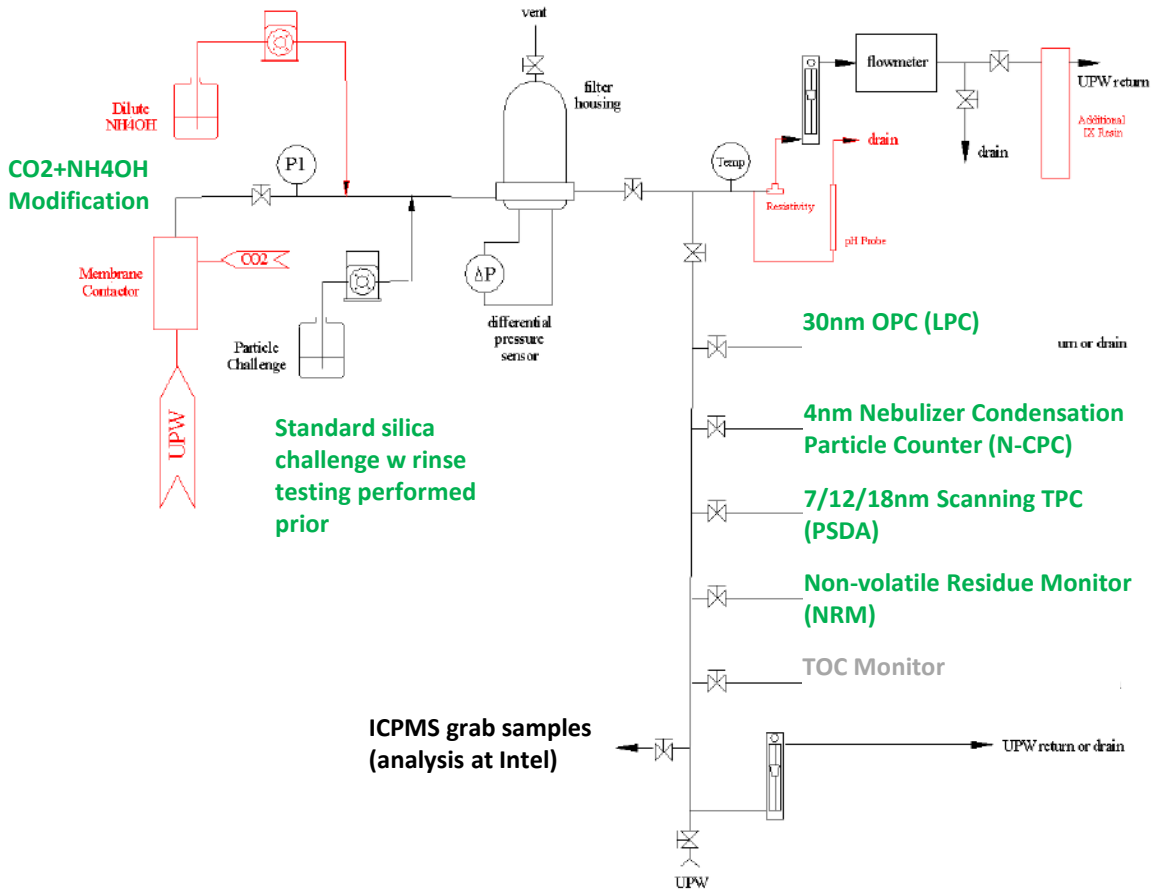
# Experimental Plan

- Three generations of filters were tested using SEMI C79-0819 as the guide for testing
- Current procedure uses UPW as the test fluid.
- Testing was expanded to include pH adjusted UPW using carbon dioxide for the acidic adjustment and ammonium hydroxide for the basic adjustment.

| | | Chemistry | | | |
|---|---|---|---|---|---|
| **Filter** | **Membrane Type** | **UPW** | **CO2/UPW** | **NH4OH/UPW** | **Total Filters** |
| **Generation 1 (Oldest)** | Sieving | 2 | 2 | 2 | 6 |
| **Generation 2** | Sieving | 2 | 2 | 2 | 6 |
| **Generation 3 (Newest)** | Sieving + Adsorptive | 2 | 2 | 2 | 6 |

# Experimental Setup

- **Test Stand Configuration with $CO_2$ and dilute $NH_4OH$ Provisions**

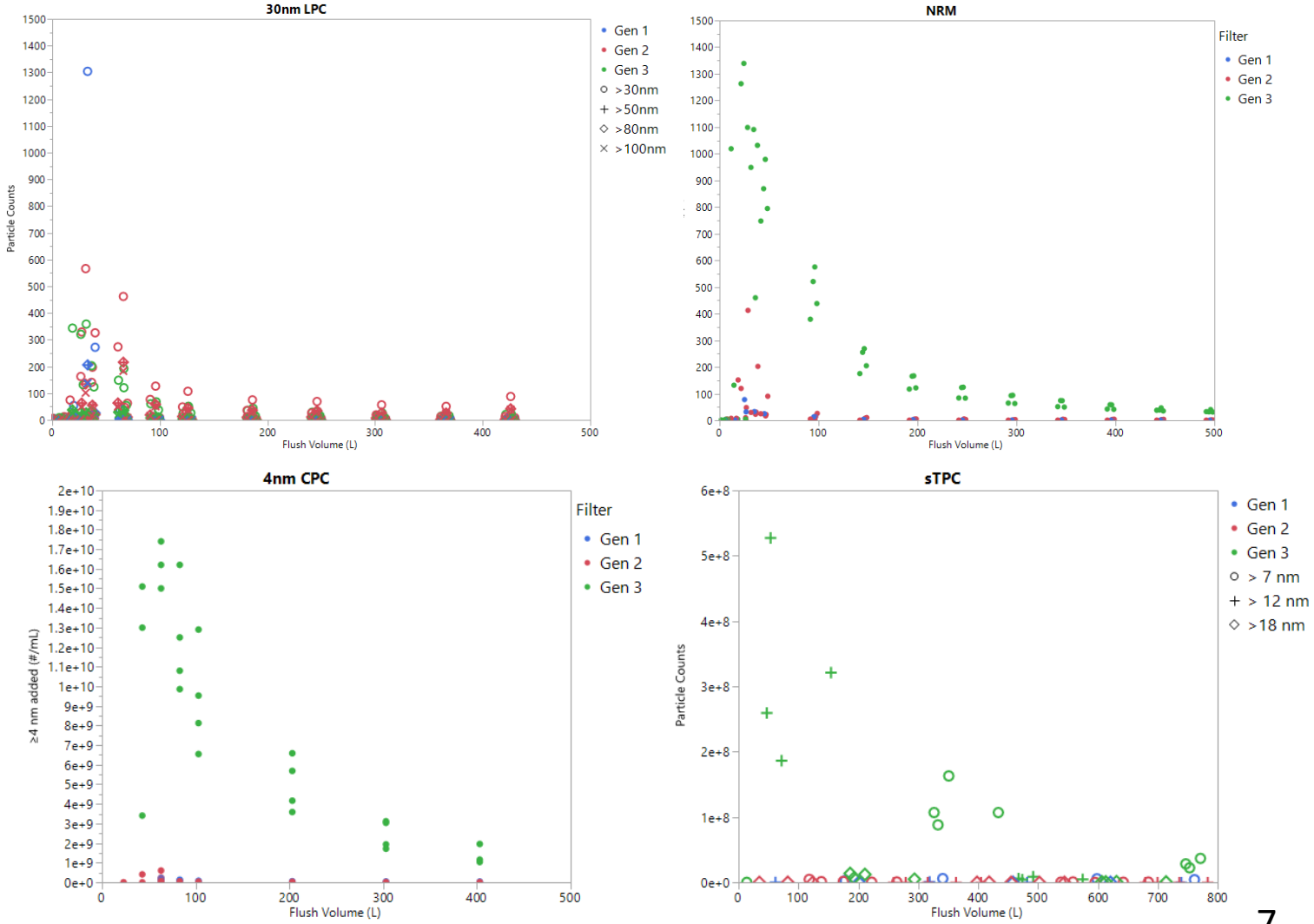


Added commas

# Observations

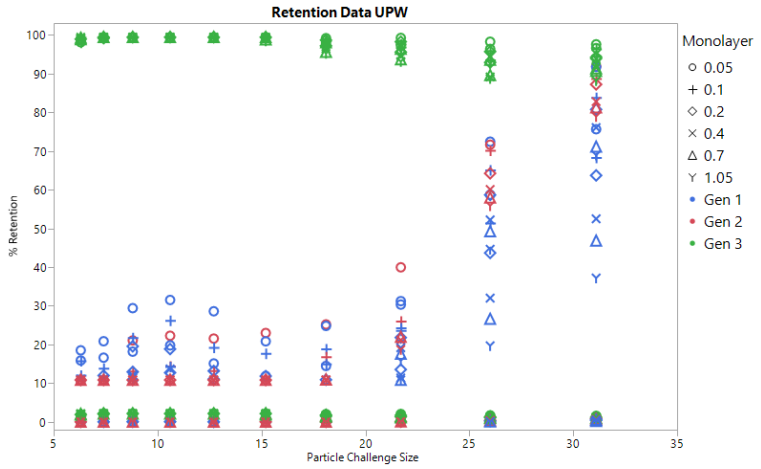
| Filter | Membrane Type | UPW Rinse in | UPW retention | CO2/UPW retention | NH4OH/UPW retention |
|---|---|---|---|---|---|
| **Chemical Environment** | | Neutral | Neutral | Acidic | Basic |
| **Generation 1 (Oldest)** | Sieving | Spike in LPC and NVR, baselining within 100L flush volume | Retention is similar and drops from >80% retention above 30nm to ~10% above 20nm | Similar performance as in UPW | Retention at low loadings is >90% across the particle range<br><br>Retention decays with particle loading <30nm |
| **Generation 2** | Sieving | | | | |
| **Generation 3 (Newest)** | Sieving + Adsorptive | Spike in LPC, NVR, sTPC, and 4nm CPC, baselining within 500L flush volume | >98% retention across the particle range | | |

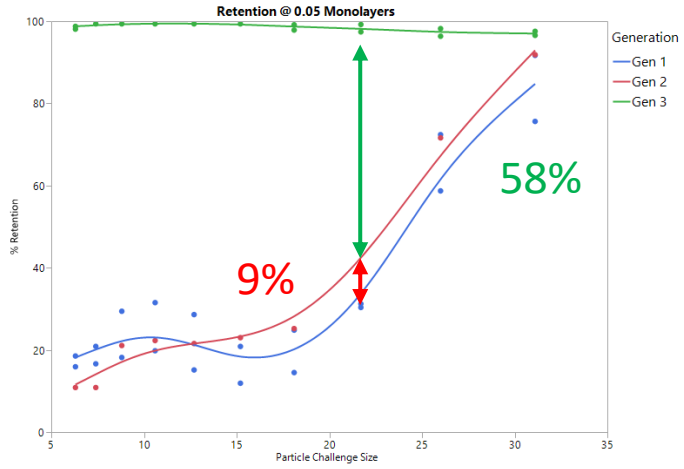
# Rinse Performance in UPW

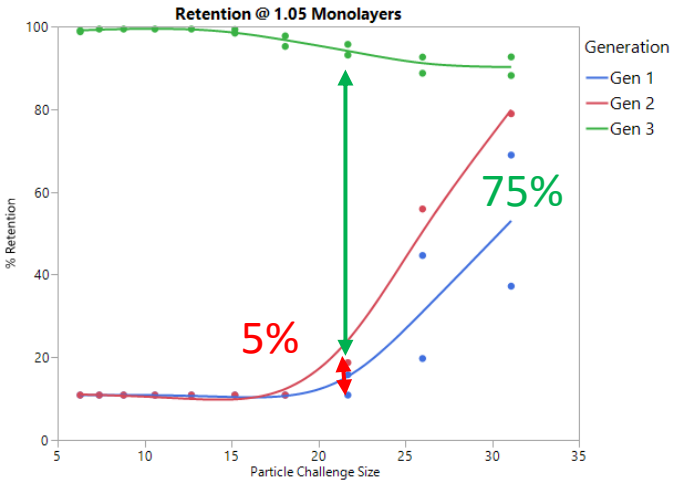


Great slide!!

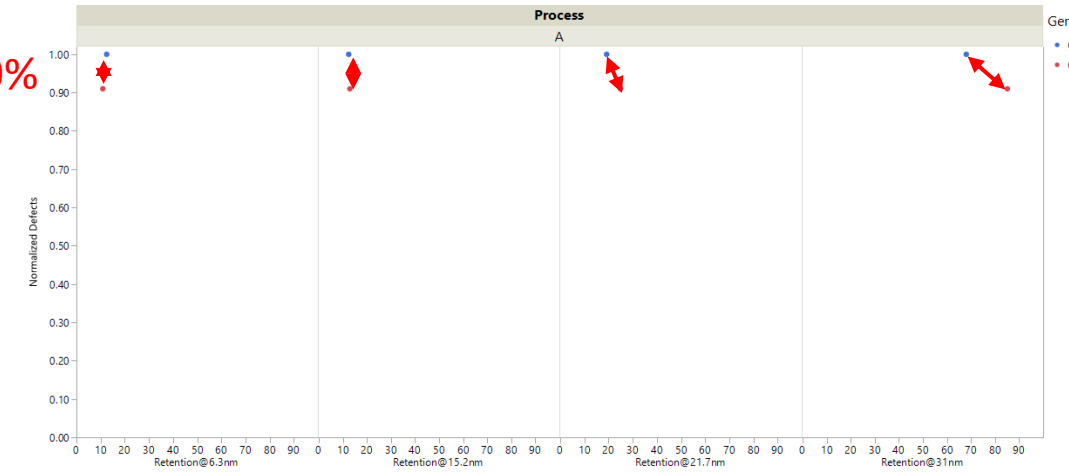
# Defect Performance versus Retention Performance



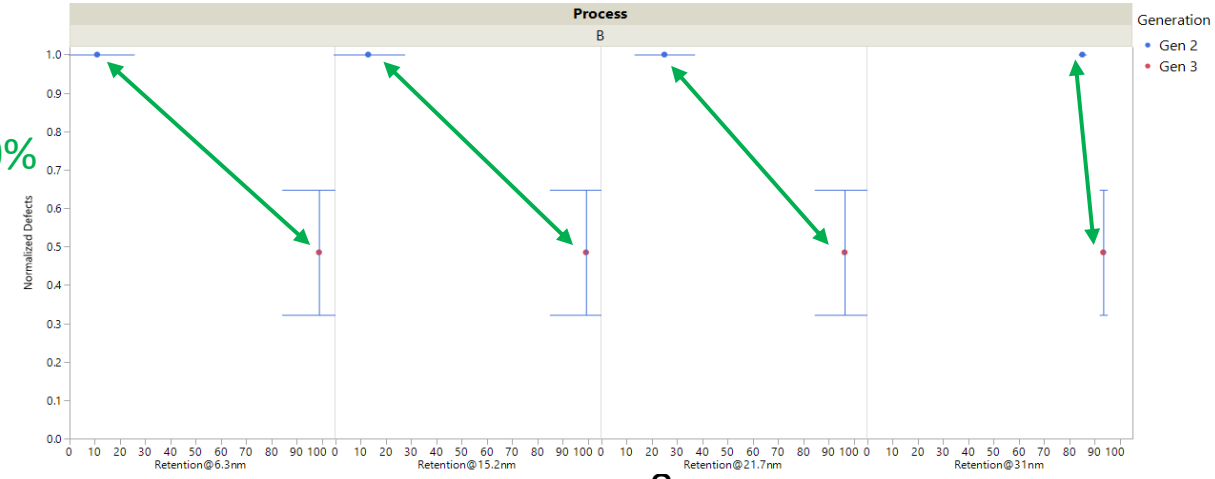




10%

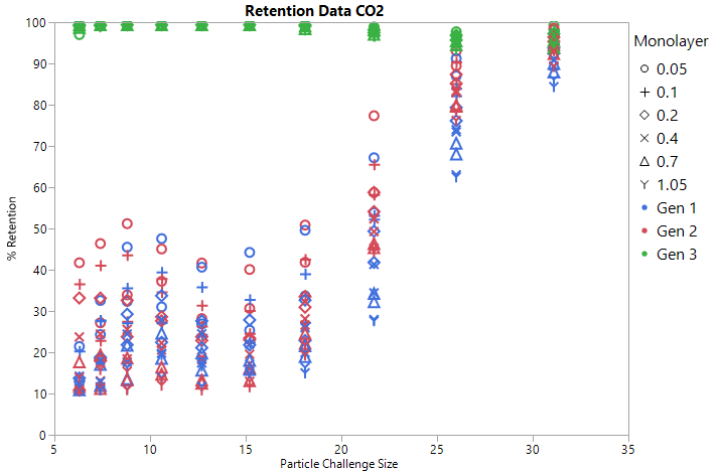


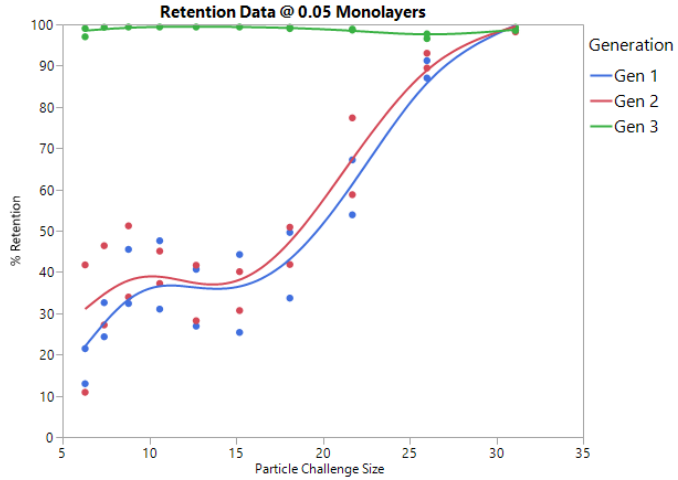

50%

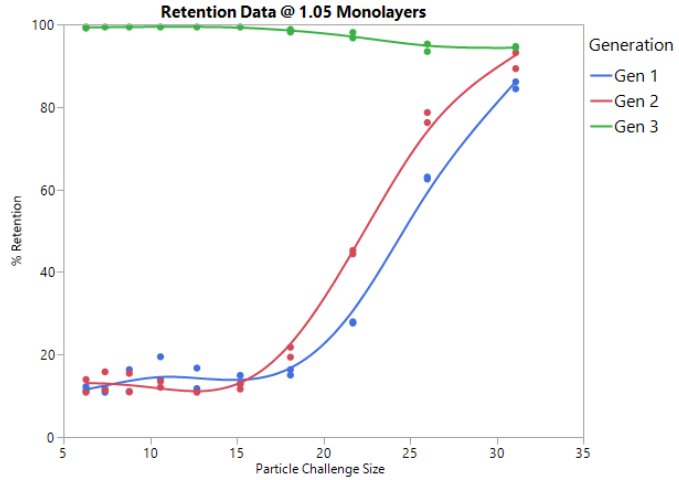


# Retention Performance in Acidic/Basic Water

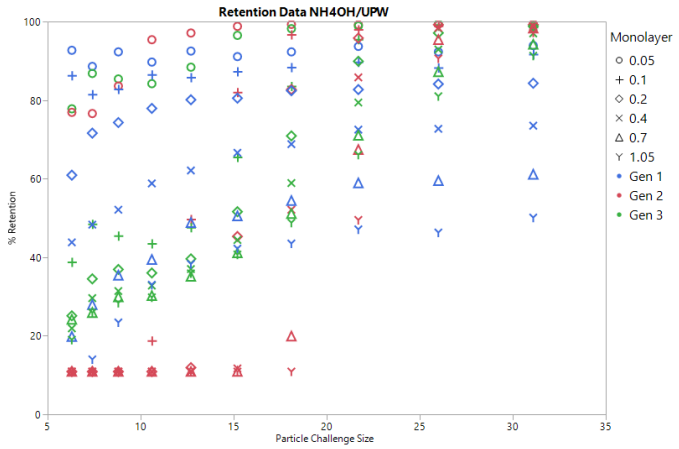
**CO2/ UPW**

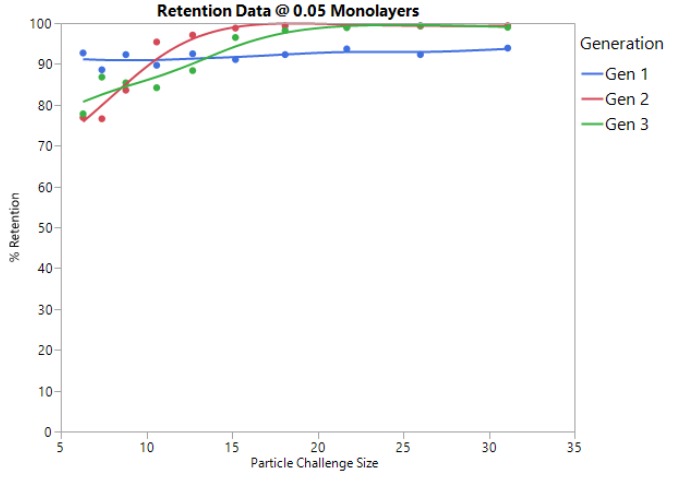


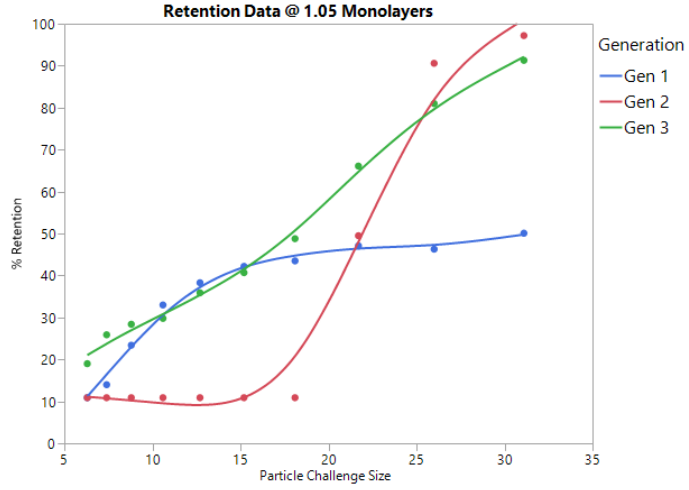




**NH4OH/ UPW**



# Conclusions

- C79 methodology shows correlation to inline performance
- C79 Methodology looks useful as a leading indicator of filter performance
  - Reduce the need for tool time
  - Speed up development
- Next Steps for development of C79
  - Expand particle/defect challenge types
  - Expand methodology for other critical chemistries
- Help Needed
  - Standardize use of C79 for evaluating emerging filter technologies

# Thank you to

Gary Van Schooneveld (CT Associates), Hokkin Choi (Intel), Vindhya Kunduru (Intel), David Neitling (Intel), Sriram Ramamoorthy (Intel), Vani Thirumala (Intel), Intel GSC-FMO, Intel Q&R



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